AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph beginning at **page 6, line 27**, and insert the following rewritten paragraph:

According to a first invention of the gait generating device of a mobile robot of the present invention, to the end described above, a gait generating device having an instantaneous gait generating means for sequentially generating an instantaneous desired gait composed of an instantaneous desired motion of a mobile robot and an instantaneous desired floor reaction force includes a first provisional corrected motion determining means for determining a first provisional corrected instantaneous desired motion obtained by provisionally correcting the position and the posture of a predetermined part of the mobile robot from the instantaneous desired motion, a second provisional corrected motion determining means for determining a second provisional corrected instantaneous desired motion obtained by provisionally correcting the position of the predetermined part from the instantaneous desired motion while maintaining the posture of the predetermined part to be the same as the posture in the instantaneous desired motion, and a desired motion correcting means for determining a corrected instantaneous desired motion obtained by executing a true correction of the position and the posture of the predetermined part in the instantaneous desired motion on the basis of the first provisional corrected instantaneous desired motion and the second provisional corrected instantaneous desired motion. And, if all or a part of the mobile robot is expressed in terms of a model constructed of a plurality of elements, the elements

being at least either rigid bodies having inertia or mass points, the placement of elements of the model determined according to a predetermined first geometric restrictive condition, which specifies the relationship between an instantaneous motion of the mobile robot and the placement of the elements of the model, from an instantaneous desired motion generated by the instantaneous gait generating means is defined as a first placement, the placement of the elements of the model determined according to a predetermined second geometric restrictive condition, which specifies the relationship between an instantaneous motion of the mobile robot and the placement of the elements of the model, from the first provisional corrected instantaneous desired motion determined by the first provisional corrected motion determining means is defined as a second placement, and the placement of the elements of the model determined according to the second geometric restrictive condition from a second provisional corrected instantaneous desired motion determined by the second provisional corrected motion determining means is defined as a third placement, then the first provisional corrected motion determining means determines the first provisional corrected instantaneous desired motion such that the translational force component of the resultant force of the inertial forces of the elements calculated by treating the difference in the placement of the elements of the model between the second placement and the first placement as acceleration becomes substantially zero and also the moment component generated about a predetermined point by the resultant force becomes substantially a predetermined value, the second provisional corrected motion determining means determines the second provisional corrected instantaneous desired motion such that the moment component generated about the predetermined point by the resultant force of the

inertial forces of the elements calculated by treating the difference in the placement of the elements of the model between the third placement and the first placement as acceleration takes substantially the predetermined value, and the desired motion correcting means determines the sum of the result obtained by multiplying the posture of the predetermined part in the first provisional corrected instantaneous desired motion by a predetermined weight w1 and the result obtained by multiplying the posture of the predetermined part in the second provisional corrected instantaneous desired motion by a predetermined weight w2 as the instantaneous desired posture of the predetermined part in the corrected instantaneous desired motion and also determines the sum of the result obtained by multiplying the position of the predetermined part in the first provisional corrected instantaneous desired motion by the predetermined weight w1 and the result obtained by multiplying the position of the predetermined part in the second provisional corrected instantaneous desired motion by the predetermined weight w2 as the instantaneous desired position of the predetermined part in the corrected instantaneous desired motion.

Please replace the paragraph beginning at **page 10, line 19**, and insert the following rewritten paragraph:

According to the first invention, properly setting the first geometric restrictive condition and the second geometric restrictive condition and also properly setting the elements constituting the model make it possible to match the difference between the second placement and the first placement (the difference between the

placement of the elements in the second placement and the placement of the elements in the first ~~element~~ placement) to the level (degree) of the dynamic error between the first provisional corrected instantaneous desired motion (the instantaneous desired value of at least one of the position and the posture of each part of the robot determined by the first provisional corrected instantaneous desired motion) and an instantaneous desired floor reaction force generated by the instantaneous gait generating means (the instantaneous desired value of at least one of the translational force of a floor reaction force and a moment acting on the robot). Similarly, it is possible to match the difference between the third placement and the first placement (the difference between the placement of the elements in the third placement and the placement of the elements in the first ~~element~~ placement) to the level (degree) of the dynamic error between the second provisional corrected instantaneous desired motion (the instantaneous desired value of at least one of the position and the posture of each part of the robot determined by the second provisional corrected instantaneous desired motion) and an instantaneous desired floor reaction force generated by the instantaneous gait generating means. Supplementally, this matching relationship generally involves a steady offset.

Please replace the paragraph beginning at **page 16, line 10**, and insert the following rewritten paragraph:

According to a second invention of the gait generating device of a mobile robot of the present invention, a gait generating device having an instantaneous gait generating means for sequentially generating an instantaneous desired gait

composed of an instantaneous desired motion of the mobile robot and an instantaneous desired floor reaction force includes a provisional corrected motion determining means for determining a provisional corrected instantaneous desired motion obtained by provisionally correcting the position and the posture of a predetermined part of the mobile robot from the instantaneous desired motion and a desired motion correcting means for determining a corrected instantaneous desired motion obtained by executing a true correction of the position and the posture of the predetermined part in the instantaneous desired motion. And, if all or a part of the mobile robot is expressed in terms of a model constructed of a plurality of elements, the elements being at least either rigid bodies having inertia or mass points, the placement of elements of the model determined according to a predetermined first geometric restrictive condition, which specifies the relationship between an instantaneous motion of the mobile robot and the placement of the elements of the model, from an instantaneous desired motion generated by the instantaneous gait generating means is defined as a first placement, the placement of the elements of the model determined according to a predetermined second geometric restrictive condition, which specifies the relationship between an instantaneous motion of the mobile robot and the placement of the elements of the model, from the provisional corrected instantaneous desired motion determined by the provisional corrected motion determining means is defined as a second placement, and the placement of the elements of the model determined according to the second geometric restrictive condition from the corrected instantaneous desired motion determined by the desired motion correcting means is defined as a third placement, then the provisional corrected motion determining means determines the provisional

corrected instantaneous desired motion such that the translational force component of the resultant force of the inertial forces of the elements calculated by treating the difference in the placement of the elements of the model between the second placement and the first placement as acceleration becomes substantially zero and also the moment component generated about a predetermined point by the resultant force takes substantially a predetermined value, and the desired motion correcting means determines the sum of the result obtained by multiplying the posture of the predetermined part in the provisional corrected instantaneous desired motion by a predetermined weight w1 and the result obtained by multiplying the posture of the predetermined part in the instantaneous desired motion generated by the instantaneous gait generating means by a predetermined weight w2 as the instantaneous desired posture of the predetermined part in the corrected instantaneous desired motion and also determines the instantaneous desired position of the predetermined part in the corrected instantaneous desired motion such that the moment component generated about a predetermined point by the resultant force of the inertial forces of the elements calculated by treating the difference in the placement of the elements of the model between the third placement and the first placement as acceleration becomes substantially a predetermined value.

Please replace the paragraph beginning at **page 37, line 4**, and insert the following rewritten paragraph:

More specifically, if the aforesaid instantaneous desired motion is

determined using a dynamic model constructed, assuming that the inertial force generated at or near the middle portion of each movable member due to a bending motion of the movable member is substantially zero (in other words, the inertial force being ignored), then the dynamic accuracy between the instantaneous desired motion and an instantaneous desired floor reaction force generated by the instantaneous gait generating means tends to deteriorate when a desired gait whereby the bending motion of each movable member is performed relatively quickly is generated. Therefore, as with the fifteenth invention, including a mass point associated with the middle portion or the portion close thereto of each movable member in the model makes it possible to determine the first and the second provisional corrected instantaneous desired motions according to the aforesaid first invention or the provisional corrected instantaneous desired motion and the corrected instantaneous desired motion according to the aforesaid second invention as explained in relation to the first or the second invention such that the influence of the inertial force produced by the bending motion of the movable member resulting from the bending operation of the joint of the middle portion of the movable member is compensated for when determining those instantaneous desired motions. This arrangement makes it possible to improve the dynamic accuracy between those determined instantaneous desired motions and the instantaneous desired floor reaction forces determined by the instantaneous ~~desired~~ gait generating means. As a result, an instantaneous gait constructed of a corrected instantaneous desired motion according to the aforesaid first or second invention and the aforesaid instantaneous desired floor reaction force makes it possible to provide higher dynamic accuracy than an instantaneous gait generated by the instantaneous gait

generating means, while restraining changes in the posture of the aforesaid predetermined part at the same time.

Please replace the paragraph beginning at **page 66, line 2**, and insert the following rewritten paragraph:

The instantaneous values of the displacement dimension corrected body position/posture determined by the displacement dimension gait corrector 100d are supplied to a full model corrector 100e. Supplied to the full model corrector 100e are the desired instantaneous values (except for the instantaneous values of reference body positions/postures) calculated by the desired instantaneous value generator 100b in addition to the instantaneous values of displacement dimension corrected body positions/postures. The full model corrector ~~100b~~ 100e uses a full model as a dynamic model having higher dynamic accuracy than a simplified model to calculate corrected desired body positions/postures obtained by correcting displacement dimension body positions/postures, and it also calculates a corrected desired floor reaction force moment, which is the desired value of a floor reaction force moment horizontal component about a desired ZMP.

Please replace the paragraph beginning at **page 121, line 22**, and insert the following rewritten paragraph:

Subsequently, the processing proceeds to S310 wherein it is determined whether L_err lies within a predetermined range in the vicinity of zero. If the result of

the determination is YES, then the processing proceeds, via S312, to S318, which will be discussed later. On the other hand, if the result of the determination is NO, then the processing proceeds to S314 wherein a plurality of provisional candidates (Pb22_s+ΔPb22x, θb22_s) and <u>(Pb22_s+ΔPb22z, θb22_s),</u> ~~(Pb22_s+ΔPb22z, θb221_s),~~ which have been obtained by changing only the body position Pb22_s of the candidate by an extremely small amount, are determined in the vicinity of the current candidates (Pb22_s, θb22_s) of the second provisional corrected body position/posture. ΔPb22x and ΔPb22y denote predetermined values for changing the candidate Pb22_s of the first provisional corrected body position from a current value in the X-axis direction and the Y-axis direction by an extremely small amount. Then, the same processing as that of the foregoing S306 and S308 is carried out on these provisional candidates so as to determine the inter-model angular momentum product error L_err. This processing of S314 is the processing for observing the degrees of changes in L_err when only the candidate of the body position out of the candidates (Pb22_s, θb22_s) of the second provisional corrected body position/posture is changed from the current value.

Please replace the paragraph beginning at **page 144, line 17**, and insert the following rewritten paragraph:

The corrected desired foot position/posture (trajectory) with deformation compensation are sent from the composite-compliance operation determiner 104 to the robot geometric model 102. The corrected desired foot position/posture with deformation compensation means the desired foot position/posture of each foot 22

that have been corrected such that an actual floor reaction force detected by the six-axis force sensor 50 approximates a desired floor reaction force, considering the deformation of the compliance mechanism 72 of each leg 2. Upon receipt of the desired body position/posture (trajectory) and the corrected desired foot position/posture with deformation compensation (trajectory), the robot geometric model 102 calculates joint displacement commands (values) for twelve joints of the legs 2 and 2 that satisfy them and sends the calculated commands (values) to the displacement controller 108. The displacement controller 108 uses the joint displacement commands (values) calculated by the robot geometric model 102 as desired values to carry out follow-up control of the displacement of the twelve joints of the robot 1. The robot geometric model 102 also calculates displacement ~~specification~~ command (values) of arm joints that satisfy desired arm postures and sends the calculation results to the displacement controller 108. The displacement controller 108 uses the joint displacement commands (values) calculated by the robot geometric model 102 as desired values to carry out follow-up control of the displacement of the twelve joints of the arms of the robot 1.

Please replace the paragraph beginning at **page 148, line 1**, and insert the following rewritten paragraph:

Fig. ~~18~~ 19 shows a structure of a simplified model (dynamic model) in the present embodiment, and Fig. 18 shows a structure of a first displacement dimension correcting model in the present embodiment.

Please replace the paragraph beginning at **page 149, line 12**, and insert the following rewritten paragraph:

The expressions (dynamic equations) describing the dynamics of the simplified model are represented by the following expressions 14 to 16. However, for the convenience of understanding of the present description, only the equations of motions on a sagittal plane (a plane that includes a longitudinal axis (X-axis) and a vertical axis (Z-axis)) will be described, and equations of motions on a lateral plane (a plane that includes a lateral axis (Y-axis) and a vertical axis (Z-axis)) will be omitted here. The variables of Expressions 14 to 16 are defined as follows: Zsup: Vertical position of supporting leg foot mass point; Zswg: Vertical position of free leg foot mass point; Zb: Vertical position of body mass point; Xsup: Horizontal position of supporting leg foot mass point; Xswg: Horizontal position of free leg foot mass point; Xb: Horizontal position of body mass point; θby: Body posture angle about Y-axis relative to vertical direction; mb: Mass of body mass point; msup: Mass of supporting leg foot mass point; mswg: Mass of free leg foot mass point; J: Inertial moment of flywheel; Fx: Horizontal component of floor reaction force; Fz: Vertical component of floor reaction force; and My: Floor reaction force moment about desired ZMP (specifically, a component of floor reaction force moment about the lateral axis (Y-axis)).

Please replace the paragraph beginning at **page 155, line 14**, and insert the following rewritten paragraph:

Geometric restrictive condition (3): Relative to a given arbitrary instantaneous desired motion, the placement of the body mass point A1 and the body link among the elements of the first displacement dimension correcting model agrees with the placement determined on the basis of the position/posture of the body 3 of the robot 1 in a given instantaneous desired motion, the position of each of the foot mass points A4 and A5 agrees with the placement determined on the basis of the position/posture of each foot of the robot 1 in the given instantaneous desired motion, and the position of each of the thigh mass points ~~A3 and A4~~ <u>A2 and A3</u> agrees with the position of a predetermined internally dividing point on the segment that connects the center of the hip joint and the center of the ankle joint of each leg 2 in the given instantaneous desired motion.

Please replace the paragraph beginning at **page 163, line 15**, and insert the following rewritten paragraph:

Supplementally, according to the present embodiment, the positions of the mass points ~~A5 and A6~~ <u>A4 and A5</u> of both feet of each displacement dimension correcting model are identical to those of both displacement dimension correcting models. Therefore, terms related to the mass points ~~A5 and A6~~ <u>A4 and A5</u> of both feet may be omitted when calculating the inter-model overall center-of-gravity error Gc_err and the inter-model angular momentum product error L_err in S208.

Please replace the paragraph beginning at **page 165, line 24**, and insert the following rewritten paragraph:

Supplementally, according to the present embodiment, the positions of the mass points ~~A5 and A6~~ A4 and A5 of both feet of each displacement dimension correcting model are identical to those of both displacement dimension correcting models. Therefore, as with the processing of the aforesaid S208, the terms related to the mass points ~~A5 and A6~~ A4 and A5 of both feet may be omitted when calculating the inter-model angular momentum product error L_err in S308.

Please replace the paragraph beginning at **page 176, line 6**, and insert the following rewritten paragraph:

Then, according to the present embodiment, a displacement dimension corrected body posture is determined by using the foregoing expression 12 and expression 13 ~~are used for the determination~~ based on the body position/posture of the first provisional corrected gait and the body position/posture of the second provisional corrected gait described above in the same manner as that in the first embodiment. Thus, as with the first embodiment, if the operation mode of the robot 1 steadily remains the normal mode, then the displacement dimension corrected gait will be a gait obtained by correcting the body position of a simplified model gait without changing the body posture (without correcting the body posture), thus achieving higher dynamic accuracy between a motion and a floor reaction force moment of a displacement dimension corrected gait than that of the simplified model gait.

Please replace the paragraph beginning at **page 200, line 21**, and insert the following rewritten paragraph:

Further, in the first to the third embodiments discussed above, the number of mass points of each leg 2 in the first and the second displacement dimension correcting model has been two; alternatively, however, a displacement dimension correcting model that has a mass point in each of, for example, a portion in the vicinity of the foot 22~~2~~, a crus link, and a thigh link of each leg 2 (three mass points in each leg) may be constructed. In this case, as with the second or the third embodiment, if the positions of the mass points of the first displacement dimension correcting model are to be restricted, then two mass points other than the mass point of each foot may be set at, for example, two points defined by a predetermined internally dividing ratio on a segment that connects the center of an ankle joint and the center of a hip joint. Moreover, a rigid body (link) having inertia corresponding to a crus link and/or a body link may be added as an element of both displacement dimension correcting models.

Please replace the paragraph beginning at **page 201, line 18**, and insert the following rewritten paragraph:

Further, in the first to the third embodiments described above, if a desired gait is generated for performing a motion in which the robot 1 stops and sticks out both arms 5 and 5 forward when the operation mode of the robot 1 is, for example, the aforesaid normal mode (other than the running mode and the low-friction floor

surface walking mode), then a mass point or inertia may be imparted to a part corresponding to each arm 5 in the first and the second displacement dimension correcting models.

Please replace the paragraph beginning at **page 202, line 1**, and insert the following rewritten paragraph:

Further, if the elbow joints of both arms 5 and 5 are bent or stretched, mass points corresponding to the elbow joints or in the vicinity thereof may be provided, as in the case where thigh mass points are provided in the first and the second displacement dimension correcting models in the second and the third embodiments. More specifically, as shown in, for example, Fig. 27, elbow mass points B8 and B9 respectively corresponding to the vicinity of the elbow joints of the arms 5, and hand tip mass points B6 and B7 respectively corresponding to the vicinity of the distal portions of the arms 5 are provided in addition to the body mass point B1, the thigh mass points B2, B3, and the foot mass points B4, B5 in the first and the second displacement dimension correcting models, and an arrangement is made such that the elbow mass points B8 and B9 are restricted to the points defined by a predetermined internally dividing ratio on a segment connecting the center of a shoulder joint and the center of a wrist joint of each arm 5 in the first displacement dimension correcting model. In addition, as with the second or the third embodiment, the first provisional corrected body position/posture are determined such that the inter-model overall center-of-gravity error Gc_err and the inter-model angular momentum product error L_err, including the differences of the positions of

the elbow joints B8 and B9 between the first displacement dimension correcting model and the second displacement dimension correcting model, approximate zero (satisfy the aforesaid conditions 1 and 2). Also, the second provisional corrected body position/posture are determined such that the inter-model angular momentum product error L_err approximates zero ~~or satisfies~~ (satisfies the aforesaid condition 2) in a state wherein the body posture is identical to the body posture of a simplified model gait or identical to the sum of the result obtained by multiplying the first provisional corrected body posture by the foregoing weight w1 and the result obtained by multiplying the body posture of the simplified model gait by the foregoing weight w2. Regarding the first displacement dimension correcting model, the arm postures of the first displacement dimension correcting model may be restricted to the arm postures in the upright posture state of the robot 1 (the posture in which they are stretched in the vertical direction), as in the case where the postures of the legs 2 have been restricted in the first embodiment.